

**STRATEGIC  
OBJECTIVE**

**2**

## **Accelerate Progress in Cancer Prevention**

**We will accelerate the discovery, development, and delivery of cancer prevention interventions by investing in research focused on risk assessment, systems biology, behavior modifications, environmental and policy influences, medical and nutritional approaches, and training and education for research and health professionals.**

Prevention is our first line of defense against cancer. Preventing cancer focuses on understanding and modifying behaviors that increase risk, mitigating the influence of genetic and environmental risk factors, and interrupting carcinogenesis through early medical intervention. Dramatic developments in technology and a more complete understanding of the causes and mechanisms of cancer will enable us to provide more effective ways to prevent the disease. Identifying critical molecular pathways of pre-cancers will provide new drug targets for preempting cancer. Transdisciplinary research will provide a more complete understanding of the interplay of molecular, behavioral, genetic, and other factors contributing to cancer susceptibility. We must systematically identify the most promising advances, harness their application for new prevention approaches, and encourage and monitor the adoption of prevention interventions in public health and clinical settings. It is imperative that evidence-based advances shown to inform and motivate people are disseminated and made accessible.



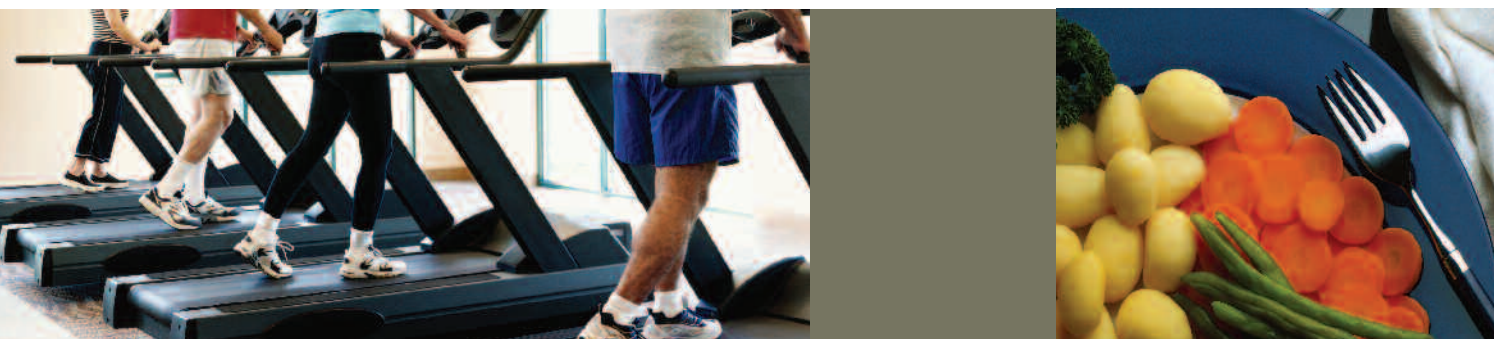
**STRATEGY 2.1**—Develop a transdisciplinary systems approach to explore the biology behind successful cancer prevention.

Cancer is a complex array of diseases that are not always demonstrated or predicted by examining individual processes, thus making cancer prevention exceedingly challenging. NCI will use a systems biology approach, emphasizing early events and modifiability to develop effective cancer prevention strategies<sup>1</sup>. We will:

- > Build teams to merge laboratory, epidemiologic, and clinical approaches for identifying factors that influence cancer initiation and progression and improve the effectiveness of preventive interventions.
- > Support the development and use of technologies that incorporate and analyze detailed genomic, epigenomic, transcriptomic, proteomic, and metabolomic information to determine individual cancer susceptibility and detect precancerous conditions.
- > Support the use of technologies to identify and validate molecular targets that can be modulated to reduce cancer occurrence and progression and to identify robust biomarkers that will inform patient-specific risk/benefit analyses for prevention regimens.
- > Develop molecular imaging techniques to non-invasively detect modifications to molecular targets or biomarkers influenced by cancer prevention interventions.
- > Use and develop model systems to accelerate progress in identifying individuals who are likely to respond to cancer prevention approaches.
- > Support research to elucidate the mechanisms of tobacco addiction and control and encourage research to identify specific bioactive food components, dietary and physical activity patterns, and other lifestyle factors to further understand how they contribute to cancer prevention as well as to carcinogenesis.
- > Integrate preclinical and clinical investigations that incorporate the newest approaches and technologies within the biological and psychosocial domains to speed discovery of early detection biomarkers and preventive agent development.

Building on the totality of information available about cancer processes, we will be able to expand the number of effective cancer prevention strategies and help identify target populations and individuals who will benefit most from specific interventions.

<sup>1</sup> See Objective 1 to learn more about NCI's research efforts aimed at further understanding the biological mechanisms underlying cancer susceptibility.



### Diet Is an Integral Part of Both Cancer Prevention and Treatment

#### Prevention

Mounting evidence with animal models suggests that the use of foods and their components are an appropriate preemptive strategy to halt or reverse several steps in the cancer process. Likewise clinical studies point to several foods and their components as modifiers of cancer risk. Nevertheless, it is clear that not all individuals respond identically to the health benefits associated with specific foods or their components. Much of this variability in response likely reflects genetic differences among people, the amount of specific foods consumed, and the timing of intake. As we learn more about gene-nutrient interactions, we will have a clearer understanding as to who will benefit most from dietary interventions and what amounts of foods or supplements will be needed to maximize benefits while minimizing possible adverse effects.

#### Treatment

Cancer and cancer treatments can lead to food aversions and precipitate nutritional deficiencies. Nausea, vomiting, diarrhea, constipation, mouth sores, swallowing complications, and overall pain can not only influence eating behaviors and reduce the intake of energy and protein but also decrease the intake of a number of bioactive food components needed by patients. These deficiencies can, in turn, cause a patient to be weak, tired, and unable to resist infection. Studies are currently underway to identify sensitive biomarkers which can be used to evaluate the nutritional status of patients and determine what dietary shifts are needed to optimize chemo- or radiation therapy and promote healthy recovery.

**STRATEGY 2.2**—Develop and test behavioral approaches for reducing cancer risk, focusing on tobacco prevention and cessation, diet, exercise, weight management, sun safety, cancer screening, and avoiding excessive alcohol use.

More than half of all cancers are partially related to modifiable behavioral factors that affect the risk for cancer at all stages of its development. These include tobacco use, diet, physical inactivity and excess weight, sun exposure, cumulative exposure to radiation, failure to get cancer screening, and excessive alcohol use.

Research is needed to understand and address these factors for patients across all age groups, racial and ethnic populations, socioeconomic strata, geographic areas, and with cancer diagnoses. NCI will:

- > Support integrated, multidisciplinary studies of behavior and behavioral change, taking into account the social, psychosocial, environmental, lifestyle, policy, cultural, and biological and genetic determinants of cancer.
- > Support research to understand how people perceive risk, make informed and shared decisions regarding behavior, and maintain healthy behavior or change risky behavior.
- > Support research to develop innovative behavioral and community-based interventions to promote preventive and health maintenance behavior.

There are significant barriers to getting people to change their behaviors. A greater understanding and dissemination of research and best practices on how to motivate people to adopt healthy behaviors will help reduce cancer risk for individuals and communities and ultimately decrease cancer incidence.

The evidence is now clear that obesity is a significant risk factor in many cancers. Overweight and obesity in the United States may account for 14 percent of all cancer deaths in men and 20 percent in women, adding up to more than 94,000 deaths each year. In women, increased body mass is associated with higher rates of cancers of the breast, endometrium, cervix, and ovary. In men, excess weight increases stomach and prostate cancer risk.

**STRATEGY 2.3**—Study the impact of environmental and policy interventions on cancer risk.

Environmental and policy interventions focusing on efforts such as restricting tobacco sales to minors, increasing the price of cigarettes, and instituting smoke-free workplaces and public places have been found to reduce tobacco use. A supportive physical environment that provides features such as walking paths, sidewalks, bike paths, and attractive stairwells has been shown to encourage physical activity. NCI will:



- > Support research on population-based behavior and how to change risk behavior and reduce cancer risk through environmental and other policy.
- > Advance research to assess behavior change resulting from health campaigns that promote the availability of healthy foods in a variety of settings, such as fast food restaurants and schools, and changes to the built environment encouraging physical activity. Investigate how best to overcome barriers to screening and medical care such as lack of transportation and limited availability and implement policies that provide insurance coverage for prevention and early detection services. Investigate the impact of comprehensive clean indoor air laws on tobacco use behavior.
- > Develop analytic strategies to evaluate interventions targeting the environment and lifestyle and the influence of behavioral, social, and psychological factors on those interventions.

Scientific evidence regarding the effectiveness of environmental and policy interventions will inform future decision making and lead to public policy that promotes the adoption of healthy behaviors and the prevention of many cancers.

### **Reducing Tobacco Use Is Still a Major Cancer Prevention Strategy**

Lung cancer is the leading cancer killer in both men and women with annual rates in recent years of more than 163,000 deaths and over 172,000 new cases diagnosed. Researchers estimate that 87 percent of lung cancer cases are caused by smoking.

Cigarette smoke contains more than 4,000 different chemicals, many of which are proven cancer-causing substances, or carcinogens. The longer a person smokes, the greater his or her risk of lung cancer. When a person stops smoking, the risk of lung cancer begins to decrease. After ten years, the risk drops to one third to one half the level of people who continue to smoke. Many of the chemicals in tobacco smoke are also carcinogenic for people who inhale secondhand smoke, which is responsible for approximately 3,000 lung cancer deaths each year.

New medications to help smokers quit are under development and current evidence shows that information and referrals from quit phone lines as well as behavioral counseling from healthcare providers significantly increase the numbers of people who quit.

### **STRATEGY 2.4—Develop medical interventions that suppress cancer initiation and progression.**

Scientific advances are providing new evidence for the potential use of drugs, vitamins and minerals, vaccines, food constituents, and other substances to slow, halt, or reverse precancerous conditions in people at risk for cancer. NCI will:

- > Support a robust cancer prevention agent development program to identify the most promising synthetic and natural agents to prevent or delay cancer onset.
- > Advance studies to identify agents that interfere with carcinogenesis by affecting cellular targets.
- > Support large-scale clinical trials to test the ability of these agents to modify biomarkers of carcinogenesis and ultimately to prevent or delay cancer onset.
- > Continue to support a consortium of research centers for conducting clinical trials to assess the potential of new agents and other approaches to inhibit the cancer process.

Medical interventions, in combination with lifestyle and environmental changes, hold great promise to dramatically reduce cancer incidence in future generations.





**STRATEGY 2.5**—Develop and support a periodic systematic review of the epidemiologic evidence on possible carcinogens and other cancer risk factors.

With an ever increasing number of published epidemiologic studies exploring suspected carcinogens and other cancer risk factors, public health and clinical practitioners, regulatory agencies, and policy makers need authoritative and rigorous evidence-based reviews that integrate the knowledge gained from individual studies to identify meaningful findings. NCI will:

- > Support the development of a guide to cancer risk factors, similar to the prevention research evidence reviews reflected in the *Guide to Community Preventive Services* and the *Guide to Clinical Preventive Services*.
- > Continue to work through the Interagency Cancer Epidemiology Research Funders to identify funding partners, develop an administrative structure for this project, implement a peer-reviewed process for nominating and completing evidence-based reviews, and develop a dissemination plan to deliver valid evidence-based cancer prevention interventions to targeted audiences.
- > Continue to work with the International Agency for Research on Cancer to develop monographs on the Evaluation of Carcinogenic Risks to Humans.

Reviews such as these will identify evidence on carcinogens and other social, behavioral, lifestyle, and environmental risk factors that is clear and consistent enough to justify public health policy and/or regulatory action<sup>2</sup>.

<sup>2</sup> See Objective 5, Strategy 5.6, to learn about NCI's research on how to disseminate, adopt, and implement new cancer interventions.

**STRATEGY 2.6**— Apply new knowledge and best practices to rapidly increase the adoption of evidence-based cancer prevention interventions in public health and clinical practice settings.

The most progress will be made in preventing cancer when new approaches to cancer prevention are widely disseminated, adopted, and implemented. NCI will support research and programs to increase the demand for and use of evidence-based cancer prevention interventions in public health and clinical practice and to influence cancer prevention policies.

**STRATEGY 2.7**— Develop and sustain a prevention outcome monitoring system to evaluate the impact of dissemination and diffusion programs on the prevalence of evidence-based prevention interventions over time.

While cancer surveillance systems like the Surveillance, Epidemiology, and End Results program (SEER), when linked to clinical service payment systems like Medicare, can monitor the uptake of treatment innovations in defined populations of cancer patients, no comparable system exists for monitoring the adoption of evidence-based cancer prevention interventions in public health or clinical practice. We

will examine existing NCI platforms that might help address this need and work with other agencies, including the Agency for Healthcare Research and Quality and the Centers for Disease Control and Prevention, to explore opportunities to collaborate and cooperate in initiating such a monitoring system. These efforts will set the stage for developing a new and unique system to track the diffusion of cancer prevention innovations and determine the association between changes in cancer risk factors and the success or failure in adopting evidence-based prevention interventions.

The Cancer Control PLANET World Wide Web portal brings together information about new evidence-based tools that can help public health officials assess the cancer and/or risk factor burden in a given geographic area, identify potential partner organizations, understand current research findings and recommendations, access and download information about evidence-based programs and products, and find guidelines for planning and evaluation. Go to [cancercontrolplanet.cancer.gov](http://cancercontrolplanet.cancer.gov).



**STRATEGY 2.8**—Equip scientists, clinicians, and other health professionals with the principles, methods, and practices needed for cancer prevention research and education.

Strategies to prevent cancer depend on a cadre of investigators and practitioners. NCI will build a comprehensive education and training program in cancer prevention and control at the graduate and postdoctoral levels and for continuing education. We will prepare people to participate effectively in cancer prevention as a multidisciplinary process that incorporates the most recent advances and technologies in the genetic, molecular, behavioral, nutritional, and social sciences as well as those used in traditional health sciences such as epidemiology, environmental health, and biostatistics. We will use a comprehensive training initiative to encourage and support innovative transdisciplinary research and professional development. Additionally, NCI will build upon its efforts to bring the science and practice of cancer prevention to developing countries through fellowships and summer short course exchange programs.

The NCI Cancer Prevention Fellowship Program provides postdoctoral training opportunities in cancer prevention and control. The purpose of the program is to train individuals from transdisciplinary health sciences in the field of cancer prevention and control. For more information, go to [cancer.gov/prevention/pob](https://cancer.gov/prevention/pob). For information on the full range of fellowships and internships supported by NCI, go to [cancer.gov/researchand-funding/fellowships](https://cancer.gov/researchand-funding/fellowships).

### **Large-Scale Clinical Trials Are Integral to Cancer Prevention Drug Development**

Large-scale, chemoprevention trials are a final step in a long and careful research process to identify medicines, vitamins, minerals, or food supplements that help to prevent cancer. These multi-year trials monitor large numbers of healthy people who are assigned to take either the test chemoprevention agent or a placebo. Investigators analyze outcomes data to determine whether fewer people in the group taking the test agent develop cancer in comparison with the placebo group. Data on side effects are used to weigh the potential risks versus benefits of widespread and individual use of the prevention agent. Recent NCI-supported chemoprevention trials have led to the FDA approval of tamoxifen for breast cancer prevention and have demonstrated the feasibility of prostate cancer chemoprevention.